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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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EXAMINER
MUHAMEDULLA, S

ART UNIT	PAPER NUMBER
1756	4

DATE MAILED: 05/24/00

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

09/320,946

Applicant(s)

KAMON, KAZUYA

Examiner

Saleha R. Mohamedulla

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).

Status

- 1) ☒ Responsive to communication(s) filed on 26 May 1999.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) 25 and 26 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☒ Claims 1-26 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).
- a) ☒ All b) ☐ Some * c) ☐ None of the CERTIFIED copies of the priority documents have been:
1. ☒ received.
2. ☐ received in Application No. (Series Code / Serial Number) _____.
3. ☐ received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. & 119(e).

Attachment(s)

- 15) ☒ Notice of References Cited (PTO-892)
- 16) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.
- 18) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 19) ☐ Notice of Informal Patent Application (PTO-152)
- 20) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claims 1-24, drawn to a mask and a method of making a mask, classified in class 430, subclass 5.
 - II. Claims 25 and 26, drawn to a method of making an integrated circuit, classified in class 438, subclass 30.

The inventions are distinct, each from the other because of the following reasons:

2. Inventions Group I and Group II are related as product and process of use. The inventions can be shown to be distinct if either or both of the following can be shown: (1) the process for using the product as claimed can be practiced with another materially different product or (2) the product as claimed can be used in a materially different process of using that product (MPEP § 806.05(h)). In the instant case, the product can be used in a materially different process such as a method of making a semiconductor device having a gate electrode.
3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.
4. During a telephone conversation with Mr. Charles Wieland on April 11, 2000, a provisional election was made with traverse to prosecute the invention of Group I, claims 1-24. Affirmation of this election must be made by applicant in replying to this Office action. Claims

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25 and 26 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Information Disclosure Statement

5. References listed in the IDS, Paper No. 2, were provided by the Applicant in Japanese. They have been considered to the extent possible, since the Examiner does not read Japanese. The Examiner requests the Applicant's assistance in obtaining an English translation of the references listed.

Specification

6. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 3, 4, 6, and 8-15 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 4, the phrase "is gradually small" is unclear. The Examiner suggests changing the phrase to "gradually decreases". Correction is required.

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Regarding claims 3, 6 and 8, the phrase "is gradually thin" is unclear. The Examiner suggests changing the phrase to "gradually decreases". Correction is required.

Regarding claims 9-15, the phrase "type" renders the claim(s) indefinite because the claim(s) include(s) elements not actually disclosed (those encompassed by "type"), thereby rendering the scope of the claim(s) unascertainable. See MPEP § 2173.05(d). In the claims, it is unclear as to what phase shift pattern is used because the indefinite term "type" is recited. Correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

8. Claims 1, 2, 5, 7, 9-11, 14, 20 and 22 are rejected under 35 U.S.C. 102(b) as being anticipated by US# 5,437,947 to Hur et al.

Hur teaches an edge enhancement or highlighting phase shift mask with auxiliary shifters. The mask is a Levenson mask. The mask also includes a phase shift pattern of a shifter shading type with a shade pattern.

To form the mask, Hur teaches a transparent quartz substrate is coated with a patterned photoresist film. The photoresist is a mask to form a trench in the substrate by etching the

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substrate. The photoresist is removed, and chrome, a light-shading material, is deposited over the substrate, filling the trench in the substrate. Chemical and mechanical polishing is performed to form a smooth surface for the transparent substrate. An oxide phase shifting layer is then deposited and is coated with a photoresist that is patterned. The photoresist is a mask to pattern the underlying oxide layer and the photoresist is removed (Figs. 9A-9F; col. 5, lines 3-25).

Hur also teaches in another embodiment forming a patterned photoresist layer over a transparent substrate and etching the substrate to form grooves. The resist is eliminated and a light shading material is deposited over the substrate, filling the trench in the substrate. Chemical and mechanical polishing is performed to form a smooth surface for the transparent substrate. A phase shifting oxide layer is formed over the substrate and a patterned photoresist 27 is formed over the oxide layer 26. The resist layer 27 is used to form phase shifter pattern 28 in fig. 5f. The substrate is then etched to form grooves 29 in Fig. 5h (col. 4, line 30-50; Figs. 5a-5h)

9. Claims 1, 2, 5, 7, 9-11 and 14 are rejected under 35 U.S.C. 102(e) as being anticipated by US# 5,824,439 to Lee (herein referred to as Lee '439).

Lee '439 teaches a method of manufacturing a phase shifting mask. A groove is formed in a transparent substrate. A light shading or a light-shielding layer is formed in the groove, creating a shade pattern with a shade section made up of a shade film formed in the hollow groove section. A phase-shifting layer is formed and patterned on the light shading layer (col. 4, lines 3-24). The phase shifting pattern over the light shading pattern is a reflection preventing pattern (col. 2, lines 2-7). A surface of the phase-shifting pattern is flat (Fig. 3). The

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phase shift mask of Lee '439 is a Levenson phase shift mask with auxiliary shifters and enhances the phase shifting effect at the edge portion. The mask also includes a phase shift pattern of a shifter shading type with a shade pattern.

To form the phase shifting mask, a silicon oxide or nitride layer is formed on the transparent substrate and is patterned with electron beam exposure to expose predetermined positions of the transparent substrate (col. 5, lines 10-15). A polymer layer is then coated over the silicon oxide or nitride patterned layer and the substrate. The layer is etched back with reactive ion etching to form sidewalls 35 (Fig. 4B). The grooved hollowed section in the substrate is formed by using the oxide or nitride layer and the sidewalls as a mask during reactive ion etching (col. 5, lines 15-28). The sidewalls are then removed. A light-shading material is deposited to fill the hollow section. The material and the substrate are polished and planarized through chemical-mechanical polishing. Part of layer is oxidized to form a phase shifting layer. The part that is not oxidized is a light-shading layer. The light-shading layer is defined to be within the groove. The oxide or nitride layer is then selectively removed to expose portions of the transparent substrate, thereby forming light transmitting portions (col. 5, lines 29-55).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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10. Claims 4 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,437,947 to Hur et al. or US# 5,824,439 to Lee (Lee '439) in view of US# 6, 017, 659 to Lee et al (herein referred to as Lee '659).

Hur teaches the limitations of claim 2 discussed in paragraph 8 above. Lee '439 teaches the limitations of claim 2 discussed in paragraph 9 above. Lee '439 or Hur does not teach that a difference of a step between the phase shift pattern and the transparent substrate is gradually small.

Lee '659 teaches a phase shifting mask, wherein the difference of a step between the phase shift pattern and the substrate gradually decreases yielding an intermediate or transition phase shifter (Figs. 8D-8G; col. 1, line 62; col. 3, lines 1-20).

The references are combinable as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the method and resulting stepped structure of Lee '659 in the mask of Hur or Lee '439 in order to eliminate the need for using extra masking steps (col. 2, lines 65-68).

11. Claims 3, 6 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,437,947 to Hur et al. or US# 5,824,439 to Lee (Lee '439) in view of US# 5, 972,540 to Lee (herein referred to as Lee '540).

Hur teaches the limitations of claims 2, 5 and 7 discussed in paragraph 8 above. Lee '439 teaches the limitations of claims 2, 5 and 7 discussed in paragraph 9 above. Lee '439 or Hur does not teach that an end section of the phase shift pattern has a sloped shape that decreases.

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Lee '540 teaches phase shift patterns that are rounded into sloped phase shift patterns on a transparent substrate (col. 5, lines 20-25, Fig. 10d).

The references are combinable as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the sloped phase-shifters of Lee '540 in the mask of Hur or Lee '439 in order to prevent pattern errors at a phase boundary (col. 2, lines 65-68).

12. Claims 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,437,947 to Hur et al. or US# 5,824,439 to Lee (Lee '439) in view of US# 5,945,237 to Tanabe.

Hur teaches the limitations of claim 2 discussed in paragraph 8 above. Lee '439 teaches the limitations of claim 2 discussed in paragraph 9 above. Lee '439 or Hur does not teach that the phase shift pattern is a half tone phase shift pattern.

Tanabe teaches a half tone phase shift pattern (col. 1, lines 30-40).

The references are combinable as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the half tone pattern of Tanabe in the mask of Hur or Lee '439 in order to improve phase mask resolution using a simply constructed mask (col. 1, lines 19-28).

13. Claims 17-19, 21 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,437,947 to Hur et al.

Hur teaches a transparent quartz substrate is coated with a patterned photoresist film.

The photoresist is formed with known lithographic techniques. The photoresist is a mask to

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form a trench in the substrate by etching the substrate. The photoresist is removed, and chrome, a light-shading material, is deposited over the substrate, filling the trench in the substrate. Chemical and mechanical polishing is performed to form a smooth surface for the transparent substrate. An oxide phase shifting layer is then deposited and is coated with a photoresist that is patterned. The photoresist is a mask to pattern the underlying oxide layer and the photoresist is removed (Figs. 9A-9F; col. 5, lines 3-25).

Hur also teaches in another embodiment forming a patterned photoresist layer over a transparent substrate and etching the substrate to form grooves. The resist is eliminated and a light shading material is deposited over the substrate, filling the trench in the substrate. Chemical and mechanical polishing is performed to form a smooth surface for the transparent substrate. A phase shifting oxide layer is formed over the substrate and a patterned photoresist 27 is formed over the oxide layer 26. The resist layer 27 is used to form phase shifter pattern 28 in fig. 5f. The substrate is then etched to form grooves 29 in Fig. 5h (col. 4, line 30-50; Figs. 5a-5h)

It is an obvious variation of the method of Hur to perform chemical-mechanical polishing of the oxide phase shift pattern in order to planarize the surface of the phase shift layer. It is obvious as the invention of Hur teaches chemical-mechanical polishing of the transparent substrate to achieve the same goal of a smooth planar surface.

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14. Claims 16 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,437,947 to Hur et al. in view of US# 6,037,083 to Mitsui.

Hur teaches a transparent quartz substrate is coated with a patterned photoresist film. The photoresist is formed with known lithographic techniques. It is obvious to a skilled artisan to use an electron beam, a laser beam or monochromatic beam as radiation to expose the photoresist as these forms of radiation are commonly used in the art to pattern photoresists. The photoresist is a mask to form a trench in the substrate by etching the substrate. The photoresist is removed, and chrome, a light-shading material, is deposited over the substrate, filling the trench in the substrate. Chemical and mechanical polishing is performed to form a smooth surface for the transparent substrate. An oxide phase shifting layer is then deposited and is coated with a photoresist that is patterned. The photoresist is a mask to pattern the underlying oxide layer and the photoresist is removed (Figs. 9A-9F; col. 5, lines 3-25).

It is an obvious variation of the method of Hur to perform chemical-mechanical polishing of the oxide phase shift pattern in order to planarize the surface of the phase shift layer. It is obvious as the invention of Hur teaches chemical-mechanical polishing of the transparent substrate to achieve the same goal of a smooth planar surface.

Hur does not teach forming a second reflection preventing film on the oxide phase shifting layer. Mitsui teaches a second reflection preventing metal film on a phase shifting half tone film to create a half-tone phase shifting mask (Fig. 10, col. 11, lines 27-30).

The references are combinable as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the second reflection preventing film of Mitsui in the mask of Hur or Lee '439 in order to be

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able to properly etch the underlying phase shift material and yield improved optical characteristics. The second layer of Mitsui exhibits high acid resistance and high reliability (col. 2, lines 48-65).

Conclusion

15. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Saleha Mohamedulla whose telephone number is (703) 308-1260. The Examiner can normally be reached Monday through Friday, from 8:00am to 4:30pm. If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor, Sharon Gibson, can be reached on (703) 308-4552. The fax phone number for the organization where this application or proceeding is assigned is (703) 305-3599. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

srm

May 15, 1999

CYNTHIA HARRIS KELLY
PRIMARY EXAMINER
GROUP 1260/1700

C. Kelly